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**Response under 37 C.F.R. 1.116  
- Expedited Examining Procedure -  
Examining Group 1772**

**MAIL STOP AF  
83613AEK**

**Customer No. 01333**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of:

Robert P. Bourdelais, et al

**MICROVOIDED LIGHT DIFFUSER  
CONTAINING OPTICAL CONTACT  
LAYER**

Serial No. 10/017,002

Filed 14 December 2001

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA. 22313-1450

Sir::

Group Art Unit: 1772

Examiner: Marc A. Patterson

I hereby certify that this correspondence is being deposited today with the United States Postal Service as first class mail in an envelope addressed to Commissioner For Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

*Deidra L. Mack*  
Deidra L. Mack

*May 24, 2004*  
Date

**DECLARATION UNDER RULE 132**

The undersigned, Cheryl J. Brickey (nee Kaminsky), declares that:  
She has received the degree of B.S. in Chemical Engineering from  
Carnegie Mellon University;

She has been employed as a research scientist with Eastman Kodak  
Company since August 2000;

She is an inventor in the above-captioned patent application;  
She has reviewed the outstanding Office Action and any applicable  
cited references;

She has prepared samples of the invention as well as a sample of a  
reflective polarizer and tested them as detailed in Part A that follows:

She has prepared samples of a multilayer of the invention in varying  
thicknesses to determine the effect of varying layer thickness on light transmission  
and diffusion as detailed in Part B that follows.

**PART A - Comparison Example vs a Sample for this Application (Example 4)**

A transparent amorphous film composed of three layers having an overall width of 16 cm was manufactured by a co-extrusion process. One of the outer layers, hereafter referred to as layer (A), was composed of poly(ethylene terephthalate) ("PET", commercially available from Eastman Chemical Company as Eastapak #7352). The intrinsic viscosity (I.V.) of the PET 7352 resin was 0.74. This layer was approximately 245  $\mu\text{m}$  in thickness. The center layer, hereafter referred to as layer (B), was composed of PET (commercially available from Eastman Chemical Company as Eastapak #9921) impregnated with a particulate voiding agent. The intrinsic viscosity (I.V.) of the PET 9921 resin was 0.80. This layer was approximately 30  $\mu\text{m}$  in thickness. The remaining outer layer, hereafter referred to as layer (C), was composed of PET 7352. This layer was approximately 10  $\mu\text{m}$  in thickness.

The voiding agent was created as follows. A 27 mm twin screw compounding extruder heated to 275°C was used to mix polystyrene beads cross-linked with divinylbenzene with PET 9921. The beads had an average particle diameter of 2  $\mu\text{m}$ . The beads were added to attain a 20% by weight loading in the PET 9921 matrix. All components were metered into the compounder and one pass was sufficient for dispersion of the beads into the polyester matrix. The compounded material was extruded through a strand die, cooled in a water bath, and pelletized.

Prior to the film co-extrusion process, the PET 7352 resin and the compounded pellets were dried separately in desiccated driers at 150°C for 12 hours. The cast sheet was co-extruded in an A/B/C layer structure. A standard 3.18 cm diameter screw extruder was used to extrude the PET 7352 resin for layer (A). A standard 1.91 cm diameter screw extruder was used to extrude the compounded pellets for layer (B). A standard 3.18 cm diameter screw extruder was used to extrude the PET 7352 resin for layer (C). The 275°C melt streams were fed into a 7 inch multi-manifold die also heated at 275°C. As the extruded sheet emerged from the die, it was cast onto a quenching roll set at 60 - 70°C.

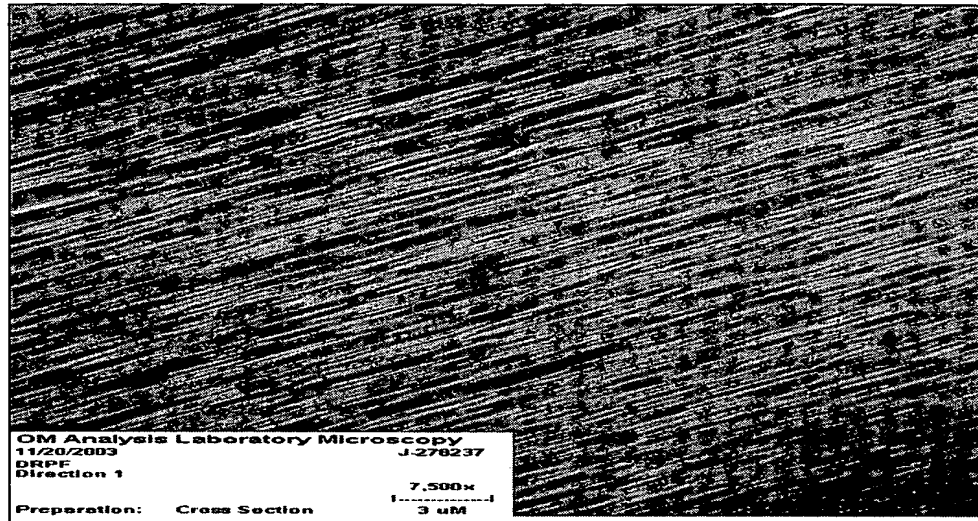
The amorphous cast sheet was cut into 13 cm x 13 cm squares. The sheet was then stretched simultaneously in the X and Y-directions using a standard laboratory film stretching unit. The cast sheet was stretched symmetrically in the X and Y-directions to an extent of approximately 3.5 times the original sheet dimensions. The sheet temperature during stretching was 103°C. The processing conditions are shown in the table below.

|   |      |
|---|------|
| Example Number                          | 4    |
|   | Inv  |
| Cast Layer (A) Thickness (micron)       | 245  |
| Cast Layer (B) Thickness (micron)       | 30   |
| Cast Layer (C) Thickness (micron)       | 10   |
| Approximate Symmetric Stretching Extent | 3.5X |
| Stretching Temperature (degree C)       | 103  |
| Stretched Layer (A) Thickness (micron)  | 20   |
| Stretched Layer (B) Thickness (micron)  | 2    |
| Stretched Layer (C) Thickness (micron)  | 1    |
| Percent Total Transmission at 500 nm    | 76.5 |
| Percent Diffuse Transmission at 500 nm  | 73.6 |
| Percent Spectral Transmission at 500 nm | 2.9  |
| Percent Diffuse Reflection at 500 nm    | 27.7 |

**Reflective Polarizer Comparison Sample (US 6,057,961 (Allen et al.) and US 5,825,543 (Ouderkirk et al.))**

The comparison example is a reflective polarizer, DRPF (Diffuse Reflective Polarizing Film) commercially available from 3M. This film was made according to US patents 6,057,961 and 5,825,543. The sample is a mixture of polyethylene naphthalate (PEN) and syndiotactic polystyrene (sPS). The PEN and the sPS are mixed together in an extruder, extruded onto a casting wheel to produce a flat sheet, and cooled. The film is then heated again and stretched uniaxially.

A TEM (transmission electron microscope) image of the cross-section of the film is below. The continuous phase and the discontinuous phase shown are polymeric.



### **LCD-Grade Absorptive Polarizer**

This is a typical absorptive polarizer from a liquid crystal display. It is formed of 2 pieces of cellulose triacetate sandwiching a layer of stretched PVA stained with iodine. It is not an example but may be used to observe the lack of light transmission through the comparison reflective polarizer. The enclosed absorptive polarizer allows for approximately 100% the desired polarization of light through the film but absorbs approximately 100% of the orthogonally polarized light, resulting in a net of 50% transmission. When it is placed with the Reflective Polarizer Comparison Sample and rotated, it is clear that only 50% of the light is passed because the light transmission is virtually nil at the proper orientation, each polarizer absorbing 50% of the incident light.

### **Comparison Optical Data of Examples**

|  | Sample for D83613 | Reflective Polarizer<br>Comparison Sample |
|--|-------------------|---|
| Percent Total Transmission                 | 76.5              | 48.3                                      |
| Percent Diffuse Transmission               | 73.6              | 19.0                                      |
| Percent Diffuse Transmission<br>Efficiency | 96.2              | 39.3                                      |

*Percent diffuse transmission efficiency is the percent diffuse transmission divided by the percent total transmission times 100.*

The resulting data demonstrates that the diffuse light transmission and the total light transmission of the reflective polarizers of the cited art are far below that of the inventive comparisons. I would not expect a polarizer to have a total transmission beyond 50% in view of its intended function to prevent passage of the light that is wrongly polarized which is half the light.

### **PART B - Effect Of Layer Thickness Variations**

A transparent amorphous film composed of three layers having an overall width of 16 cm was manufactured by a co-extrusion process. One of the outer layers, hereafter referred to as layer (A), was composed of poly(ethylene terephthalate) ("PET", commercially available from Eastman Chemical Company as Eastapak #7352). The intrinsic viscosity (I.V.) of the PET 7352 resin was 0.74. This layer was approximately 245  $\mu\text{m}$  in thickness. The center layer, hereafter

referred to as layer (B), was composed of PET (commercially available from Eastman Chemical Company as Eastapak #9921) impregnated with a particulate voiding agent. The intrinsic viscosity (I.V.) of the PET 9921 resin was 0.80. This layer was approximately 30  $\mu\text{m}$  in thickness. The remaining outer layer, hereafter referred to as layer (C), was composed of PET 9921 and impregnated with a particulate voiding agent of a different size than the voiding agent in layer (B). This layer was approximately 48  $\mu\text{m}$  in thickness. All voided layers in each example were impregnated with approximately the same concentration of void initiating beads and thus have approximately the same frequency of voids.

The particulate voiding agents were created as follows. A 27 mm twin screw compounding extruder heated to 275°C was used to mix polystyrene beads cross-linked with divinylbenzene with PET 9921. The beads used for layer (B) had an average particle diameter of 2  $\mu\text{m}$ . The beads used for layer (C) had an average particle diameter of 5  $\mu\text{m}$ . The beads were added to attain a 20% by weight loading in the PET 9921 matrix. The components were metered into the compounder and one pass was sufficient for dispersion of the beads into the polyester matrix. The different size beads were compounded in two separate batches. The compounded material was extruded through a strand die, cooled in a water bath, and pelletized.

Prior to the film co-extrusion process, the PET 7352 resin and the compounded pellets were dried separately in desiccated driers at 150°C for 12 hours. The cast sheet was co-extruded in an A/B/C layer structure. A standard 3.18 cm diameter screw extruder was used to extrude the PET 7352 resin for layer (A). A standard 1.91 cm diameter screw extruder was used to extrude the compounded pellets for layer (B). A standard 3.18 cm diameter screw extruder was used to extrude the compounded pellets for layer (C). The 275°C melt streams were fed into a 7 inch multi-manifold die also heated at 275°C. As the extruded sheet emerged from the die, it was cast onto a quenching roll set at 60 - 70°C.

The amorphous cast sheet was cut into 13 cm x 13 cm squares. The sheet was then stretched simultaneously in the X and Y-directions using a

standard laboratory film stretching unit. The cast sheet was stretched symmetrically in the X and Y-directions to an extent of approximately 3.5 times the original sheet dimensions. The sheet temperature during stretching was 103°C. The processing conditions are shown in the table below.

|   |      |
|---|------|
| Example Number                          | 4    |
| Cast Layer (A) Thickness (micron)       | 245  |
| Cast Layer (B) Thickness (micron)       | 30   |
| Cast Layer (C) Thickness (micron)       | 48   |
| Average Bead Size in Layer B (micron)   | 2    |
| Average Bead Size in Layer C (micron)   | 5    |
| Approximate Symmetric Stretching Extent | 3.5X |
| Stretching Temperature (degree C)       | 103  |
| Stretched Layer (A) Thickness (micron)  | 20   |
| Stretched Layer (B) Thickness (micron)  | 2    |
| Stretched Layer (C) Thickness (micron)  | 4    |
| Percent Total Transmission at 500 nm    | 72.4 |
| Percent Diffuse Transmission at 500 nm  | 70.8 |
| Percent Spectral Transmission at 500 nm | 1.7  |
| Percent Diffuse Reflection at 500 nm    | 30.9 |

To create a thicker voided diffuser sample, two of the example films from above were adhered together using an index of refraction matching adhesive. The adhesive was 5 micrometers thick.

|                         | Thickness      | % Total Transmission | % Haze |
|-------------------------|----------------|----------------------|--------|
| Example Film            | 26 micrometers | 72.4                 | 97.2   |
| 2 Example Films Adhered | 57 micrometers | 57.7                 | 99.9   |

*(Haze is defined as the % diffuse transmission divided by the percent total transmission)*



The data shows that increasing the thickness of the layer may increase the diffuse transmission but decreases the total transmission. This may be explained by observing that as a voided diffuser increases in thickness (without changing void size, shape or density), light passes through more voids as it passes through the film. The amount of total transmission decreases and the amount of diffusion increases as thickness increases. One skilled in the art would not have expected that one could simultaneously increase both the haze and the transmission by increasing the thickness of the diffuser layer as suggested by the Examiner in the paragraph bridging pages 3 and 4 of the outstanding rejection.

The undersigned declares further that all statements made herein of the undersigned's own knowledge are true and all statements made on information and belief are believed to be true. These statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.



Cheryl J. Brickey

Date: 5/24/04